Sometimes an ounce of extracorporeal membrane oxygenation prevention is worth a pound of extracorporeal membrane oxygenation cure

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Emergency aortic valve replacement in the setting of severe aortic valve stenosis and cardiogenic shock carries increased risk of morbidity, including postcardiotomy cardiac failure.[1] Mechanical circulatory support with extracorporeal membrane oxygenation (ECMO) can be a lifesaving therapy for such patients. We report here the management of a patient with severe prosthetic aortic stenosis in cardiogenic shock whom we treated with ECMO therapy to achieve clinical stabilization before urgent aortic valve replacement.

CLINICAL SUMMARY

A 77-year old woman was admitted with a non–ST-segment myocardial infarction, severe prosthetic aortic valve stenosis, and an ejection fraction of 37%. The patient had cardiogenic shock develop and underwent placement of an intra-aortic balloon pump. This resulted in stabilization of her systemic blood pressure; however, acute kidney injury developed, with low urinary output (67 mL over 6 hours) and elevated serum creatinine level (acute increase from 1.6 to 2.2 mg/dL).

The patient was taken to the operating room for emergency reoperative aortic valve replacement. On induction of anesthesia, systemic systolic arterial hypotension (83 mm Hg) and pulmonary systolic arterial hypertension (71 mm Hg) developed. The patient required frequent intravenous boluses of epinephrine to maintain perfusion, and we did not believe that she would survive long enough to allow the planned reoperative aortic valve replacement.

We decided to proceed with ECMO therapy. Arterial cannulation was performed with a 10-mm Gelsoft graft (Terumo Cardiovascular Systems Corporation, Ann Arbor, Mich) sutured as a chimney graft to the right axillary artery. A Bio-Medicus venous cannula (Medtronic Bio-Medicus, Inc, Eden Prairie, Minn) was placed through the right femoral vein. ECMO therapy immediately stabilized the patient's hemodynamics. She had dramatic clinical improvement, with normalization of the systemic systolic arterial blood pressure (128 mm Hg), pulmonary systolic arterial pressure (39 mm Hg), urinary output (3265 mL over 24 hours), serum creatinine level (1.3 mg/dL), and chest radiographic appearance (Figure 1, *A* and *B*).

The patient was returned to the operating room 36 hours later to undergo reoperative aortic valve replacement. This operation included institution of cardiopulmonary bypass though the ECMO cannulas, resternotomy, myocardial protection with antegrade and retrograde cardioplegia, aortic root enlargement, and aortic valve replacement with a 21-mm Carpentier Edwards Perimount valve (Edwards Lifesciences, Irvine, Calif). The patient was separated from cardiopulmonary bypass without difficulty.

The postoperative course was marked by continuous improvement. The intra-aortic balloon pump was removed on postoperative day 2, and the patient was extubated on day 4. Renal function remained stable (creatinine level, 1.5 mg/dL). Discharge echocardiography showed a normally functioning prosthetic aortic valve. The patient was discharged home on day 13 with New York Heart Association class I function (Figure 1, *C*).

DISCUSSION

Clinical management of severe prosthetic aortic valve stenosis with cardiogenic shock poses a formidable challenge. Emergency operative intervention in this setting is associated with an increased risk of mortality, as noted by O'Brien and colleagues,[2] who reported a mortality odds ratio of 3.77 (95% confidence interval, 2.75–5.16) in this group of patients.

Preoperative ECMO therapy in our patient resulted in restoration of cardiac output with improvement in organ function. Other treatment options included proceeding with a balloon aortic valvuloplasty or transcatheter aortic valve replacement.[3,4] We decided against these because of (1) potential acute aortic regurgitation as the result of rupture of a bioprosthetic valve cusp, (2) nonapproved transcatheter technique, and (3) clinical improvement with ECMO therapy.

The role of preoperative ECMO therapy in patients such as ours is not well established. Larger studies are needed to define the role of ECMO therapy in acutely sick patients with aortic valve disease. The idiom, ''an ounce of prevention is worth a pound of cure,'' may have application to this group of patients.

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Disclosures: Authors have nothing to disclose with regard to commercial support.
Received for publication Aug 9, 2013; accepted for publication Aug 29, 2013; available ahead of print Oct 29, 2013.

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J Thorac Cardiovasc Surg 2014;147:1102-3
0022-5223/$36.00

http://dx.doi.org/10.1016/j.jtcvs.2013.08.084

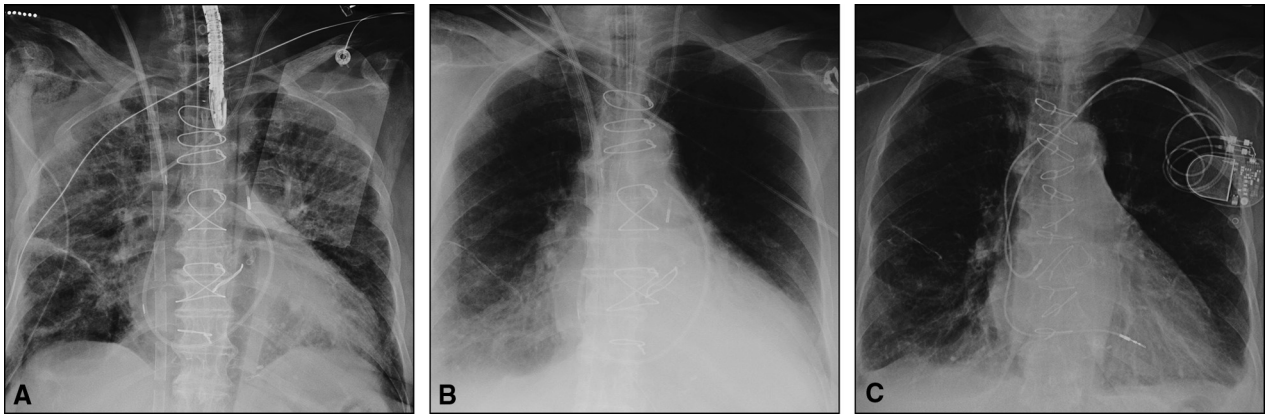

FIGURE 1. A, Chest radiograph after extracorporeal membrane oxygenation institution. B, Resolving pulmonary edema on extracorporeal membrane oxygenation support can be seen on the chest radiograph before aortic valve replacement. C, Chest radiograph before discharge from the hospital.

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Quantitative analysis of 3-dimensional aortic annular geometry: Implication for aortic root reimplantation

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The aortic valve reimplantation technique described and popularized by David and associates[1] has demonstrated consistently excellent long-term outcomes during the past 2 decades in patients with aortic root dilatation but structurally normal, trileaflet aortic valves. The success of this operation, originally conceived as an alternative to aortic root replacement in patients with Marfan syndrome, has encouraged the broader application of derivative techniques to a number of distinct clinical scenarios, including bicuspid aortic valve (BAV) syndrome with root dilatation and aortic insufficiency.[2] Transposition of these valve-sparing techniques, all of which depend on restoration of functionally normal annular and leaflet geometry, to this geometrically unique patient population requires a thorough understanding of normal 3-dimensional BAV root complex geometry.[3] To date, our collective understanding of root geometry in this patient population has largely been limited to 2-dimensional and anecdotal descriptors, which vary markedly among clinicians and institutions.[4,5] In this study, we describe the rotational orientation of the aortic valve commissures in a cohort of patients with BAV without evidence of adverse remodeling. Our findings, which describe BAV root asymmetry in quantitative terms for the first time, have substantial implications for the ongoing evolution of valve-sparing operative techniques in this patient population.

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Disclosures: Authors have nothing to disclose with regard to commercial support.

Received for publication Dec 7, 2012; revisions received March 6, 2013; accepted for publication March 15, 2013; available ahead of print Dec 11, 2013.

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J Thorac Cardiovasc Surg 2014;147:1103-5

0022-5223/$36.00

http://dx.doi.org/10.1016/j.jtcvs.2013.03.046

MATERIALS AND METHODS

Real time 3-dimensional echocardiographic data sets were acquired on 8 normal patients (tricuspid n = 4 and BAV n = 4) with an iE-33 platform (Philips Medical Systems, Andover, Mass) equipped with a 2- to 7-MHz X7-2t transesophageal echocardiography matrix-array transducer. Inclusion criteria for both groups comprised maximum root diameter less than